DOCUMENT RESUME

ED 284 676 PS 016 733

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TITLE Young Children's Perception and Comprehension of Metaphorical Similarities in Pictures and in Words.
PUB DATE Apr 87
NOTE 28p.; Paper presented at the Annual Meeting of the American Educational Research Association (Washington, DC, April 20-24, 1987).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Cognitive Ability; *Comprehension; Early Childhood Education; Foreign Countries; *Metaphors; Pictorial Stimuli; *Preschool Children; Verbal Stimuli; *Visual Perception
IDENTIFIERS Canada; Ontario (Toronto); *Similarity (Concept)

ABSTRACT

This study was designed to determine whether children 3, 4, and 5 years of age could demonstrate their metaphorical competence equally well in words and in pictures. Previous studies which have investigated young children's metaphorical ability have often encouraged young children to make judgments of similarity which rely almost exclusively on visually apparent perceptual qualities such as shape and color. This study was concerned with whether children were also capable of understanding metaphorical similarities based on implicit, not visually apparent functional and causal resemblances as well as explicit visually apparent perceptual resemblances providing that the concepts involved were familiar to the children. The results of this study indicate that all children, regardless of age, were able to recognize and explain more metaphorical similarities in pictures than in words. Therefore it appears that the mental operations required for metaphorical comprehension become available to children sometime before the age of 3. In contrast to other studies that have indicated that young children are cognitively limited to abstracting similar perceptual features between items from different categories, this study indicates that preschool children are able to give highly appropriate explanations for connecting functionally and causally related metaphors. (Author)

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Young Children's Perception and Comprehension of Metaphorical Similarities in Pictures and in Words

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Presented at the annual meeting
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American Educational Research Association
April, 1987

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ABSTRACT

This study was designed to determine whether children 3, 4, and 5 years of age could demonstrate their metaphorical competence equally in words and in pictures. Previous studies which have investigated young children's metaphorical ability have frequently encouraged young children to make judgements of similarity which rely almost exclusively on visually apparent perceptual qualities such as shape and color (Vosniadou, & Ortony 1983, Mendelson et al 1984). We were concerned with whether children were also capable of understanding metaphorical similarities based on implicit not visually apparent functional and causal resemblances as well as explicit visually apparent perceptual resemblances providing that the concepts were familiar to the children.

The results of this study indicate that all children independently of age were able to recognize and explain more metaphorical similarities in pictures than in words. Therefore it appears possible that the mental operations required for metaphorical comprehension become available to children sometime before the age of 3 years.

In contrast to other studies that have indicated that young children are cognitively limited to abstracting similar perceptual features between items from different categories, this study indicates that preschool children were able to give highly appropriate explanations for connecting functionally and causally related metaphors.

Young Children's Perception and Comprehension of Metaphorical Similarities in Pictures and in Words

This study was designed in part to determine whether task characteristics affect young children's ability to perceive metaphorical relationships. Prior studies that have investigated metaphorical thinking have almost exclusively used word tasks to assess children's metaphorical ability. However children often understand and communicate information through pictures. Furthermore infants become capable of processing purely pictorial information very soon after birth (Resnick 1977). Therefore it may very well be the case that the child's cognitive capacities do not develop in the same way or at the same rate in the verbal and pictorial symbolic domains (Gardner 1983). Consequently it is possible that the medium in which metaphorically related items are presented, (e.g. whether the task is conveyed in words or in pictures) may result in the child using quite different mental skills (Eisner 1978). To the extent that the pictorial and verbal symbol systems may require the use of different mental skills, children's ability to perceive metaphorical relationships might be expected to vary within each of these media. Consequently this study investigated children's capacity for metaphorical understanding using both word and picture tasks.

Preschool children often appear to use metaphorical expressions in their verbal language (Piaget 1962, Chukoski 1968, Carlson & Anisfeld 1979, Winner, McCarthy, Kleinman & Gardner 1979). Furthermore the first author's experience as an art teacher and art therapist has strongly suggested that preschool children frequently express themselves through complex metaphorical pictures. These phenomena appear to indicate that very young children may have the ability to perceive metaphorical similarities in both verbal and pictorial symbolic domains. We therefore decided to investigate metaphorical competence in children 3 to 5 years of age.

The Complexity of the Metaphorical Relationship

When similarities are perceived between two terms that belong to different categories (e.g. previously unrelated terms), the terms can be referred to as being metaphorically related. The attributes or features that bring the previously unrelated terms together can either be explicit or implicit. For example the metaphorical relationship between perceptually similar terms such as sun and orange can be connected by their explicit (visually apparent) similarity in shape, e.g. both are round. By contrast the similarities between the functionally related terms, horse and bicycle, are more explicit. Their functional resemblance (e.g. you can ride both a horse and a bicycle) is not visually apparent and consequently must be inferred.

Three factors add to the complexity of the metaphorical relationship:

1. The remoteness of the categories from which the relationship between the two terms is drawn. The more remote the comparison, the greater the metaphoricity.

2. Salience imbalance which occurs when the similarity perceived between two different terms is more salient or central to one of the terms than to the other (Ortony 1979, Vosniadou & Ortony, 1983). For example, the similarity derived for the two terms, angry boy and volcano, is evidence of salience imbalance; a "firey eruption" being more central or salient to a volcano than to an angry boy. By contrast similarities which are perceived between two different but perceptually similar terms lack salience imbalance. For instance, the resultant metaphorical connection "round" abstracted from the two perceptually similar terms sun and orange, are equally central or salient to both sun and orange.

3. The difficulty involved in abstracting the similarity relationship for the two terms. For example, metaphorical relationship based entirely on explicit, visually apparent perceptual characteristics such as shape, is less complex and therefore requires less cognitive activity to abstract a similarity relationship than a metaphorical relationship based on more implicit functional or causal similarities. For example as stated earlier, a metaphorical relationship between perceptually similar objects such as sun and orange are connected by virtue of their explicit, visible similarity in shape (e.g. both are round). In contrast the metaphorical relationship between functionally (or causally) similar objects such as horse and bicycle is not visually apparent. Their similar attributes, (both are used as a means of transportation) can be inferred by reflecting upon one's knowledge base (experience) for each of these entities. Consequently the mental activity required for comprehending implicit, functional (and causal) metaphorical relationships is more complex than is required for comprehending explicit perceptual metaphorical relationships. As a result the task difficulty in respect to these two different types of metaphorical relationships (perceptual, and functional and causal) can be expected to vary accordingly. The more implicit and therefore more complex functional and causal metaphorical similarities may be more difficult for children to recognize and understand than the less complex explicit perceptual metaphorical relationships.

Problems with Previous Metaphorical Materials

Young children often describe objects using their perceptual properties. Investigators have as a result frequently used tasks that encourage young children to make judgements of similarity which rely almost exclusively on similar perceptual properties between two objects, such as shape or color. Consequently we cannot be certain that young children are incapable of

perceiving more complex metaphorical relationships such as functional and causal resemblances, as well as resemblances that exhibit salience imbalance.

Vosniadou and Ortony 1983 found children as young as 3 years of age could distinguish between verbal metaphorical and anomalous comparisons, while 4 year olds were aware that the terms they connected metaphorically belonged to different conventional categories. These authors state however that "the perceptual properties of objects are very salient for children". Therefore their study relied almost exclusively on perceptual similarities.

Mendelson, Robinson, Gardner & Winner 1984 using perceptually explicit, verbal and pictorial tasks found that preschool children have the capacity to understand that the terms in the metaphor belong to different categories. These authors regard their finding as strong evidence that preschooler's metaphorical expressions are deliberate violations of conventional categories, and as a result an indication that young children are thinking metaphorically.

In a study that did examine children's ability to make judgements of similarity between pictures that did not share explicit perceptual properties (Kogan et al., 1980) they did not do very well. Children whose average age was 5 years, 10 months received an average score of .37 per item from a possible score of 2, when one point was given for recognition of similarity between two metaphorically related terms and one point was given for an appropriate explanation. However, the complexity of the pictures presented to these children appears to be more appropriate for adolescents and adults than for young children. In other words the content of these pictures may not have been familiar to the children.

In this study we used items that were familiar to young children and as well we asked children to make judgements of similarity for items that had the potential for functional and causal (implicit) resemblances as well as for

items which were perceptually (explicitly) similar. For example children were asked to indicate whether terms were metaphorically related on the basis of both inferred (not visually apparent), and perceptual (visual) similarities. In order to avoid confounding familiarity with words and pictures and ability to make similarity judgements, we considered only items that were known to the child. Furthermore we believe it is important to create trusting environment for the children. We believe that in such an environment children will respond more spontaneously to the materials and be more interested in the tasks, especially when there is a rather lengthy testing procedure. Therefore a "solid" relationship with each participant was established before his/her involvement in this study.

The Major Questions Addressed in this Study:

1. Do children demonstrate their metaphorical competence equally in words and in pictures?

For example:

a) Are children equally able to identify metaphorically related terms and distinguish them from anomalously related terms when there are presented in words and in pictures?

b) Are children equally able to explain how the terms are related metaphorically when they are presented in work and in pictures?

2. Can children's performance be explained exclusively on the basis of age related criteria? In other words can differences in metaphorical comprehension in the work and picture tasks be explained solely on the basis of developmental factors?

3. Is children's performance affected by the mode of presentations (pictures and words) as well as the complexity of the metaphorical relationship. Stated differently will children exhibit greater metaphorical competence for pictures or for words when a) Explicit perceptually related items are presented. Or will greater competence be revealed for pictures or words when (b) the items demand more inferencing on the part of children?

Method

Subjects:

The subjects were 16, 3-year-olds and 20, 4-year-olds randomly drawn from a preschool, as well as 20, 5-year-olds randomly drawn from a morning kindergarten class. The preschool and public school children were similar in socioeconomic background and all lived in the same geographic region on the outskirts of Toronto.

Some differences were noted in the backgrounds of the children, particularly the 4 year olds. These children were exposed to a learning environment which stressed language acquisition (English and Hebrew) as well as the learning of scientific concepts. Play and art was of secondary importance and was used primarily as a tool through which skills and concepts could be learned in a structured manner. Although the 3 year old preschoolers were in a somewhat similar environment as the 4 year olds, they had only been in this environment for four months in contrast to most of the 4 year olds who were in the second year of the program. Some of the 5-year-olds had previously attended preschool, some had not. The emphasis in the kindergarten was primarily on play. The learning of language and scientific concepts did not assume importance.

Materials and Design

20 concrete objects were described verbally and presented pictorially (20 words referred to concrete items and 20 pictures were based on the 20 words). The pictures which were colored were presented on laminated cardboard. Each concrete object (the "A" word and picture term, e.g. horse) had two "B" word and picture terms that went with it, either metaphorically, (e.g. bicycle) or anomalously (e.g. sweater). (See Table 1 for a list of the "A" and "B" terms that were used).

Blocks of terms were established to obtain different orders of the "A" and "B" terms through counterbalancing. The order of word and picture presentations was also counterbalanced. Four groups of children were established within each age group: Children in Group 1 received the words in Block 1; the pictures in Block 2; Children in Group 2 received the pictures in Block 1; the words in Block 2; Children in Group 3 received the words in Block 2; the pictures in Block 1; and children in Group 4 received the pictures in Block 2; the words in Block 1. Therefore within each age level, four groups of children received different orders of word and picture presentations.

Pilot Studies

Pilot studies were conducted during which the item difficulty of each set of terms (pictures and words) was determined. Items were assigned to each of the blocks on the basis that they were of equal difficulty.

Table 1

Concepts used as "A" and "B" Terms

Block 1

"A" Term	"B" Terms	
	Perceptual Metaphorical Connection	Anomalous Connection
eye	button	fork
train track	zipper	hand
moon	cookie	shoe
rain	tears	dog
beads on a string	trains on a train track	plant in a pot
shark's teeth	saw	coat
umbrella	mushroom	cat
	Inferred Metaphorical Connection	
sun	fire	book
horse	bicycle	sweater
firecracker exploding	thunderstorm	cow

Block 2

"A" Term	"B" Terms	
	Perceptual Metaphorical Connection	Anomalous Connection
plant with its leaves hanging down	lady with long hair	cow
giraffe	C.N. Tower	sun glasses
river	snake	table
lifesaver candy	tire	bag
nose	mountain	bed
sun	orange	monkey
	Inferred Metaphorical Connections	
moon	lighted candle	watering can
sun shining on a snowman	waves running over sandcastles	comb
lady taking a bath	cat licking its fur	dog's teeth
zipping up a zipper	sealing an envelope	unhappy boy

Procedure

Establishing Relationships with the Children:

The first author became a helper in the classroom for approximately four days before beginning testing. During this time children were helped with any problems they experienced such as tieing their shoe laces and getting dressed for outdoors. The children often sat on the first author's lap and told her about their families and their after school activities. In the course of playing various games the children were told that soon they would be playing a special word and picture game. In this way a trusting relationship was created preparing the children for the testing procedures that would follow.

Pretest

Prior to participating in the study, children were given a pretest for their comprehension of the words "like" and "different". They were shown three pictures of three concrete items, a red truck, a green van and a white kitchen stove and asked to select two items that were like each other and two items which were different than each other. One three year old failed to pass this test and consequently did not participate further in the study.

Preparation for Testing

After passing the pretest the children were given a pictorial example of what would be required of them in the study. Each child was presented with two pictures, a butterfly and a chair and then with another picture, an airplane. Children were then asked to select the picture (the butterfly or the chair) which wes "like" the airplane. After making their selection, the children were asked to give reasons for their choice.

If children chose the butterfly and explained that both the butterfly and airplane fly, the experimenter said, "that is correct", and then drew the

child's attention to the fact that the butterfly and the airplane were also similar because they both had wings. Likewise if the child chose the butterfly and stated that the butterfly and airplane were similar because they both had wings, the experimenter said "that is correct" and then drew their attention to the fact that both the airplane and the butterfly fly. If the child chose the chair, the experimenter drew the child's attention to the appropriate and metaphorical choice and the reasons why the metaphorical choice was appropriate and the other was not. In this way the experimenter made the child aware that the terms that would be presented to them in the study could be related in different ways. After this preparation the children immediately proceeded to the study proper.

Task

Children in each of the groups (Group 1, 2, 3 and 4) were read a word or shown a picture (e.g., shark's teeth) and then two other words or pictures (e.g., saw and coat) from which they were asked to choose a word or picture which "is like" the first word or picture (e.g., shark's teeth). For example, children in the word task were read a sentence of the form, "shark's teeth is like a" and asked to choose one of two words (saw or coat) that is like shark's teeth. If the child chose the word "saw" this would suggest that the child recognized the perceptual metaphorical resemblances (e.g. both shark's teeth and saw have sharp edges). Before selecting a word, children were asked to repeat the two possible word choices (e.g. saw and coat) to make certain they took into consideration both items.

In the pictorial task children were shown a picture (e.g. a horse) and asked to choose one of two pictures that was like the horse, (e.g. sweater and bicycle). In this example the bicycle can be understood to be like the horse on the basis of function, (e.g. you can ride both a horse and a bicycle).

(See Table 1, for other examples of verbal and pictorial terms that were used in this study).

After each choice the children were asked to state the reasons for their choice. All responses were tape recorded.

Post Tests

Previous studies designed to assess children's metaphorical ability have been criticized for using pictures and words that are not controlled for familiarity. Therefore within a week following testing children were given two post tests to determine whether they were familiar with the words and pictures used in the study.

Post Test 1

Each child was presented with all 60 pictures used in the study. The children were given the pictures one at a time and asked to describe each picture (e.g. name the object in the picture).

Post Test 2

Because it was believed that children might possibly be familiar with the item and not recall its name, a day after naming the items in the pictures each child was retested to determine if he/she was able to recognize the item he/she was unable to name in post test 1. For example the picture of each item the child was unable to name in post test 1 was presented along with three other pictures of items that the child had never seen before. The experimenter named the item the child was unable to name in post test 1. The child was then required to point to the item that was named and in this way distinguish it from the three unnamed items. If the child recognized the named item, he/she was asked a series of questions to determine if he/she was familiar with the

recognized item. (See Table 2 (P.16) for a list of questions used to determine if the child was familiar with the previously unnamed but recognized items).

Scoring

All experimental sessions were tape recorded and transcribed. Two separate scores were assigned, one for selecting the metaphorical alternative (the recognition score), and another for stating the reasons for selecting the item (the explanation score).

The Recognition Score

A score of 1 was assigned if the child selected the metaphorical alternative; a score of 0 was given if the child failed to make the metaphorical choice.

The Explanation Score

Two scorers initially examined all the transcripts and met to work out a scoring system. A four point scoring system was finally decided upon as the most reliable and accurate way of scoring the data. A score of 0 was assigned for no explanation or a completely inappropriate explanation. A score of 1 was assigned for a minimal explanation and a score of 2 for a less than complete explanation. A score of 3 was assigned when the explanation depicted the criteria of completely understanding the relationship between the two metaphorically connected items. Using these criteria the percentage agreement between the two scorers was 97.2. Disagreements were almost always for scores of 1 or 2 and were resolved by discussion.

Results

Recognition Data

To examine if young children select the metaphorical alternative

equally in pictures and in words a 2 (Block: block 1 or block 2) x 2 (Medium: pictures or words) x 2 (Complexity: perceptual or inferred) ANOVA was conducted on the children's selection of alternatives (metaphorical or anomalous). The mean score for selecting metaphorical pairs of items that were presented verbally was .71 (out of 1). The mean score for selecting metaphorical pairs of items presented pictorially was .86 (out of 1). The difference between these means which is significant $F(4.829) = 20.337$, $p < .000$ occurred because the children selected (recognized) more metaphorical pairs in the pictorially presented items than in the verbally presented items. (See Fig. 1).

To determine if children in each age level, 3 yrs., 4 yrs., & 5 yrs. selected the metaphorical alternative equally in pictures and words a 2 (Block: block 1 or block 2) x 2(Medium: pictures or words) x 2(Complexity: perceptual or inferred) ANOVA was conducted at each age level, 3 yrs., 4 yrs., and 5 yrs., considering children's selection of alternatives (metaphorical or anomalous). The 3 year olds made significantly more metaphorical selections in pictures than in words, $F(3.691) = 18.495$, $p < .000$. Although 4 year olds recognized and selected more pictorial items .84 (out of 1) than verbal items .79 (out of 1) and many more perceptual items presented pictorially .93 (out of 1) in contrast to the verbal items .78 (out of 1) there was no significant effect for medium. This occurred because the 4 year olds made more verbal inferred (causal and functional) metaphorical connections .81 (out of 1) than pictorial inferred (causal and functional) metaphorical connections, .65 (out of 1). There was a significant effect for medium for the 5 year olds, $F(2.245) = 16.231$, $p < .000$. (See Fig. 2).

To determine if children selected the metaphorical alternative more often for the pictorial items than for the verbal items independently

Mean Percent of Metaphorical Selection
Responses in Pictures and in Words

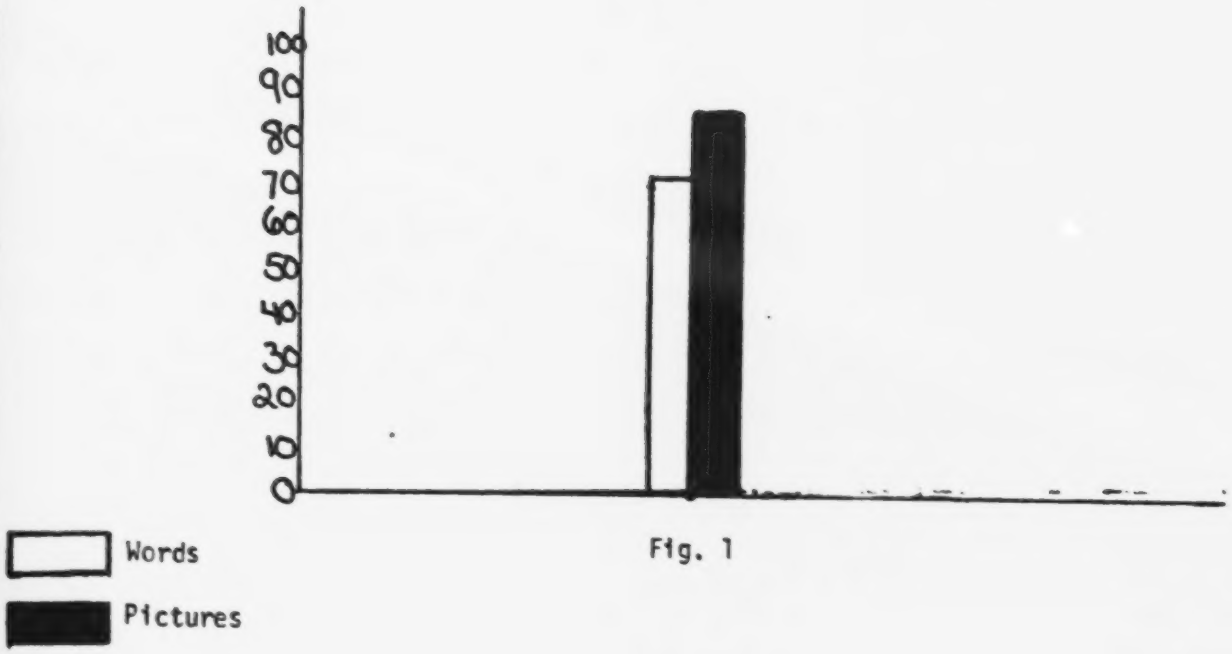

Fig. 1

Mean Percent of Metaphorical Selection
Responses in Pictures and in Words
At Each Age Level

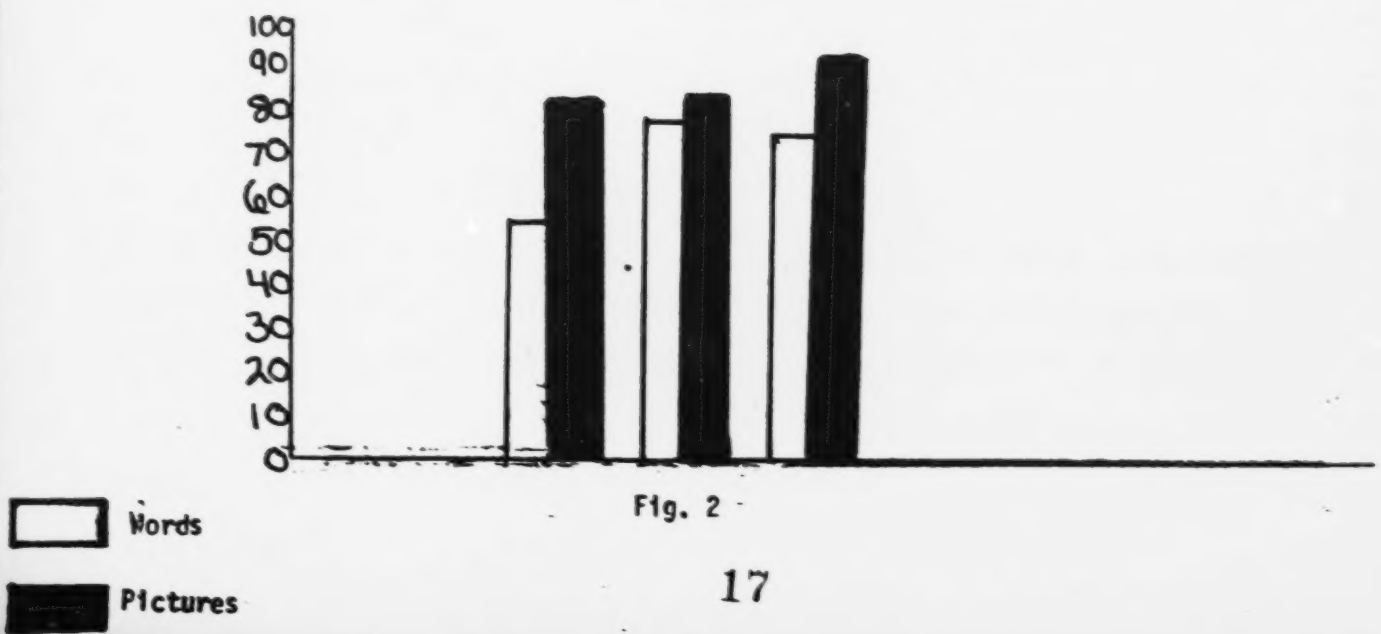

Fig. 2

of their age, a 2 (Block: block 1 or block 2) x 2(Medium: pictures or words) x 2(Complexity: perceptual or inferred) ANCOVA with age as a Covariate was conducted on the children's selection of alternatives (metaphorical or anomalous). The results showed that children independently of their age were significantly more able to select the metaphorical alternative in pictures than in words, $F(4.781) = 20.386$, $p < .000$. Therefore the differences between metaphorical selections in the work and picture tasks cannot be explained solely on the basis of developmental factors.

A revealing analysis of the data comes from examining the perceptual and inferred items at each age level, 3 years, 4 years, & 5 years. A 2(Block: block 1 or block 2) x 2(Medium: pictures or words) ANOVA for the perceptual items conducted at each age level, 3 years, 4 years, and 5 years, on the children's selection of alternatives (metaphorical or anomalous) revealed a significant effect for medium for the 3 year olds $F(5.861) = 33.972$, $p < .000$; the 4 year olds, $F(1.298) = 11.224$, $p < .001$; and for the 5 year olds, $F(2.051) = 19.334 = p < .000$. The significant differences in the media for the perceptually related items at each age level occurred because children at each age level made more perceptual metaphorical selections in pictures than in words. ANOVA for the inferred items at each age level, 3 years, 4 years, and 5 years, revealed no significant effects for medium at any of the age levels, 3 years, 4 years & 5 years. In sum these results show that each age group 3 years, 4 years, & 5 years, was significantly more able to select the less complex perceptually related metaphorical items in pictures than in words, and not significantly more able to select the more complex inferred (causally and functionally) metaphorically related items in pictures than in words. In other words children's performance was affected by the mode of presentation (pictures and words) as well as the complexity of the metaphorical relationship, perceptual (less complex) metaphorical relationships and inferred (more complex) metaphorical relationships. **(See Fig. 3)**

Questions asked in the Recognition Task

Have you ever seen (name of the item)?

If the answer is yes,

Where?

What do you do with it?

Can you tell me some other things about it?

If the item was a river the child was asked how it differed from a lake.

All children were asked if they knew what a cat did when it licks itself.

If the child was not aware that a cat washes itself when it licks itself, the item was not included in the analysis.

Table 3

The Recognition Task

The Effect of the Medium (Pictures vs. Words)

Types of Connection	Population	Mean Square	F	Significance of F
Perceptual & Inferred Metaphorical items	Total population	4.829	20.337	0.000
	Age as a Covariate	4.781	20.386	0.000
	3 year olds	3.691	18.495	0.000
	4 year olds	0.215	0.608	0.436
	5 year olds	2.245	16.231	0.000
Perceptual Metaphorical items	3 year olds	5.861	33.972	0.000
	4 year olds	1.298	11.224	0.001
	5 year olds	2.051	19.334	0.000
Inferred (Functional and Causal Metaphorical items)	3 year olds	0.154	0.601	0.441
	4 year olds	0.689	0.787	0.377
	5 year olds	0.256	1.317	0.253

Explanation Data

To examine if young children are equally able to give an appropriate explanation for making a metaphorical connection when the items are presented in pictures and in words, a 2(Block: block 1 or block 2) x 2 (Medium: pictures or words) x 2(Complexity: perceptual or inferred) ANOVA was conducted on children's explanations of why they made their selections. The mean score for correctly explaining the reason verbally presented metaphorical items should be paired was 1.36 (out of 3). The mean score for correctly explaining the reason pictorially presented metaphorical items should be paired was 1.94 (out of 3). The difference between these means which is significant, $F(72.312) = 39.750$, $p < .000$ occurred because the children were more able to explain metaphorical similarities in the pictorial items than in the verbal items. (See Fig. 4).

To determine if children in each age level, 3 years, 4 years & 5 years, were able to explain metaphorical similarities equally for the pictorial and verbal items, a 2(Block: block 1 or block 2) x 2 (Medium: pictures or words) x 2(Complexity: perceptual or inferred) ANOVA was conducted at each age level, 3 years, 4 years and 5 years on children's explanations for making metaphorical connections in the verbally and pictorially presented items. The 3 year olds make significantly more as well as qualitatively superior explanations for the pictorial items than for the verbal items, $F(81.504) = 63.003$, $p < .000$. There was a significant effect for medium for the 4 year olds, $F(12.604) = 7.104$, $p < .008$. which resulted from the 4 year olds making more as well as qualitatively superior explanations for the pictorial items than for the verbal items. Although 5 year olds made more and qualitatively better explanations for metaphorical connections in the pictorially presented items, 2.12 (out of 3), than for the verbally presented items, 1.86 (out of 3), the level of significance was $F(5.379) = 3.115$, $p < .078$. (See Fig. 5).

Mean Percent of Perceptual and Inferred Metaphorical Selection Responses in Pictures and in Words at Each Age Level

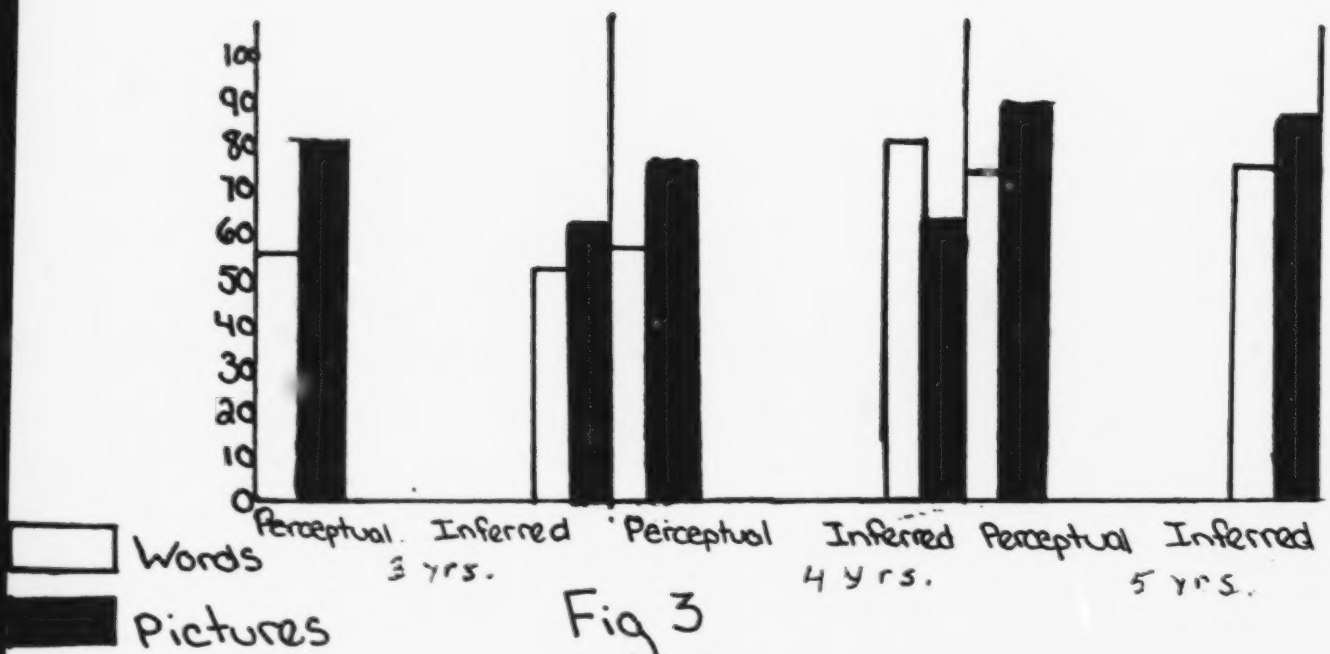

Fig 3

Mean Percent of Metaphorical Explanations in Pictures and in Words

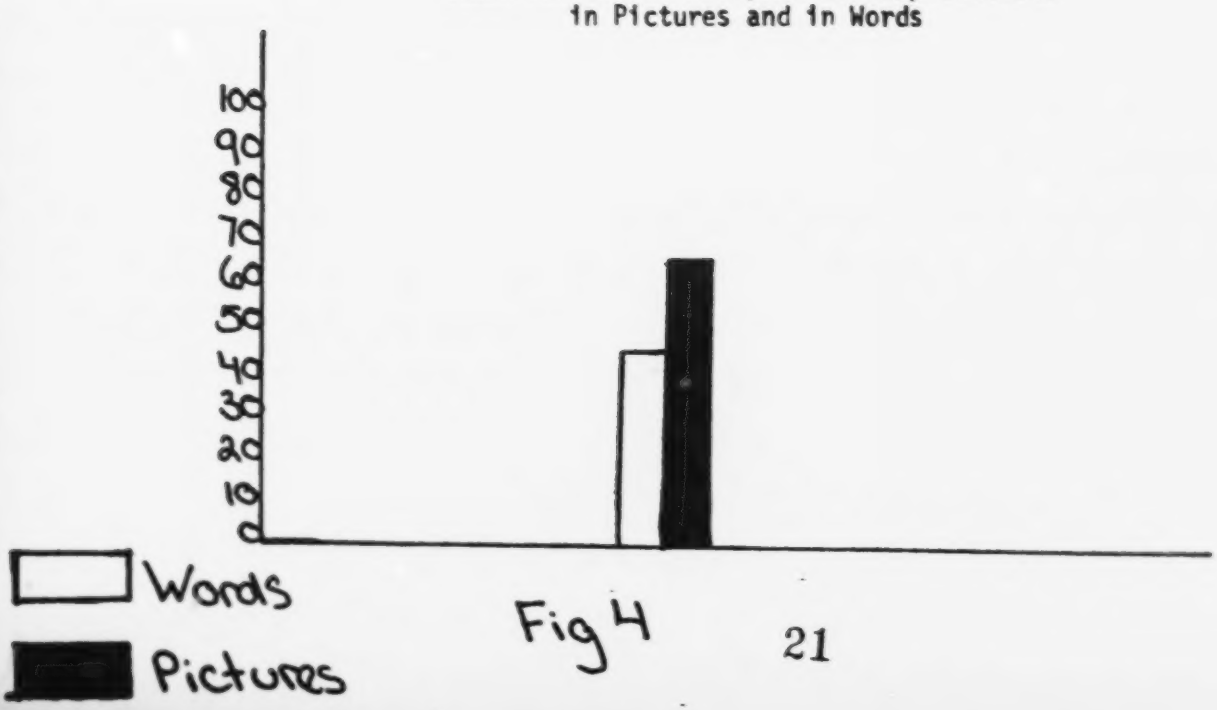

Fig 4

To determine if children were more able to give an appropriate explanation for making a metaphorical connection in the pictorial items than in the verbal items independently of their age, a 2(Block: block 1 or block 2) x 2 (Medium: pictures or words) x 2(Complexity: perceptual or inferred) ANCOVA with age as a Covariate was conducted on children's explanations of why they made their selections. The results showed that children independently of their age were significantly more able to explain why they made a metaphorical connection for the pictorial items than for the verbal items, $F(66.303) = 40.171$, $p < .000$. Therefore the differences in explaining metaphorical selections in the work and picture tasks cannot be explained solely on the basis of developmental factors.

To examine the effect of medium (pictures and words) on children's ability to explain their metaphorical connections for the perceptual (less complex) and inferred (more complex) metaphors at each age level, 3 years, 4 years, & 5 years, a 2(Block: block 1 or block 2) x 2(Medium: pictures or words) ANOVA was conducted on children's explanations of their perceptually related metaphorical selections and their inferred (causally and functionally related) metaphorical selections, for each age group, 3 years, 4 years & 5 years. ANOVA for the perceptually related items revealed a significant effect for medium for the 3 year olds, $F(112.085) = 79.749$, $p < .000$, for the 4 year olds, $F(22.431) = 12.688$, $p < .000$ and for the 5 year olds, $F(12.217) = 7.570$, $p < .006$. The significant differences in the media for the perceptually related items at each age level occurred because children at each age level made more as well as qualitatively superior explanations for the perceptual metaphorical connections in the pictorial tasks than in the verbal tasks. ANOVA for the inferred items conducted at each age level, 3 years, 4 years, & 5 years for children's explanations of their inferred (functional and causal)

metaphorical connections revealed no significant effects for medium at any of the age levels, 3 years, 4 years & 5 years. In sum these results show that at each age level 3 years, 4 years, & 5 years, children were more able to explain why they made the less complex perceptual connections in pictures than in words, but no more able to explain why they connected the more complex inferred metaphors in pictures than in words. In other words children's ability to explain their metaphorical selections is related to both the medium of presentation (pictures and words) and the complexity of the metaphorical relationship. (See Fig. 6)

Table 4

The Explanation Task

The Effect of the Medium (Pictures vs Words)

Types of Connection	Population	Mean Square	F	Significance of F
Perceptual & Inferred Metaphorical Items	Total Population	72.312	39.750	0.000
	Age as a Covariate	66.303	40.171	0.000
	3 year olds	81.504	63.003	0.000
	4 year olds	12.604	7.104	0.008
	5 year olds	5.379	3.115	0.078
Perceptual Metaphorical Items	3 year olds	112.085	79.749	0.000
	4 year olds	22.431	12.688	0.000
	5 year olds	12.217	7.570	0.006
Inferred (Functional and Causal) Metaphorical Items	3 year olds	0.273	0.263	0.609
	4 year olds	0.243	0.138	0.711
	5 year olds	1.028	0.523	0.471

Mean Percent of Metaphorical Explanations in Pictures and in Words at Each Age Level

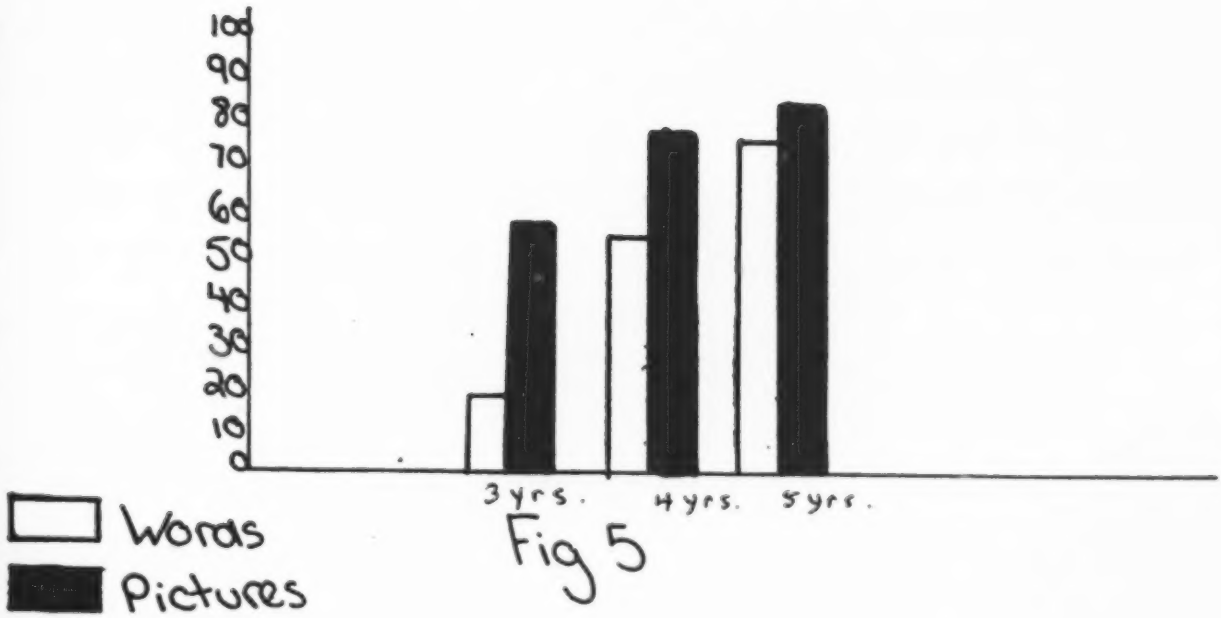

Fig 5

Mean Percent of Perceptual and Inferred Metaphorical Explanation Responses in Pictures and in Words at Each Age Level

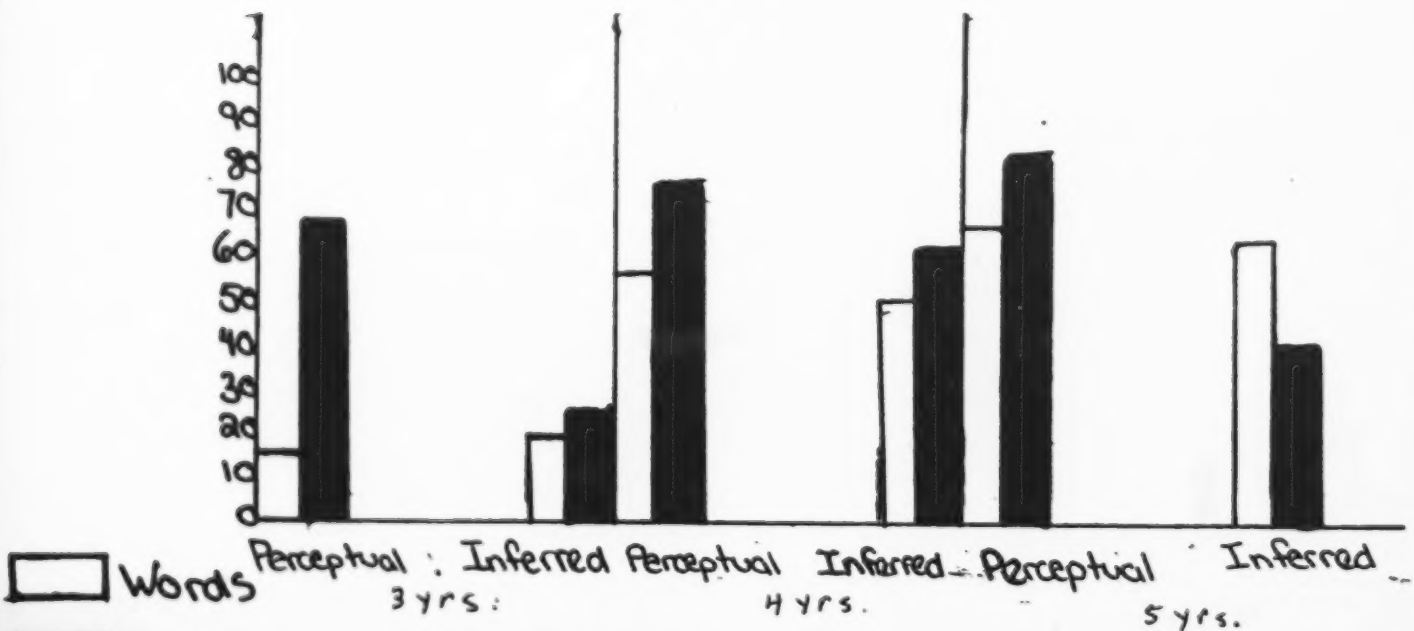

Fig 6

Discussion

Psychologists have conducted various studies which have enabled them to conclude that children are particularily adept at processing pictorial information (Pressely 1977, Gardner, 1972). The results of this study provides evidence that the picture over word superiority generalizes to metaphorical comprehension. Children of each age level 3, 4, and 5 years of age were able to select as well as provide more and qualitatively superior explanations for metaphorical connections in pictures than in words. Furthermore this picture over word supremacy occurred independently of the age of the subject. As a result these differences cannot be attributed exclusively to developmental factors. Consequently the mental operations required for metaphorical comprehension on the tasks in this study must become available to children sometime before the age of three.

There was an interaction between the complexity of the metaphorical relationship, perceptual less complex vs inferred more complex (functional and causal) metaphorical relationships and the medium of presentation (pictures and words). For example while children of each age level, 3 years, 4 years & 5 years of age were significantly more able to connect and explain explicit visually apparent less complex perceptually related items in pictures than in words, this picture over word superiority did not appear to generalize to the implicit more complex not visually apparent inferred (causal and functional) metaphorical relationships. This result may be partially explained by Resnick (1977) who summarizing the results of several studies on paired associate learning in pictures and in words, concluded that young children may not receive the benefit that is expected from pictures when images become more complex. Resnick believes that young children may have difficulty "reading" (comprehending) more complex pictures and suggests providing labels for more

complex visual arrays.

Since some of the inferred (causal and functional) metaphorical picture items (e.g. sun shining on a snowman and waves running over sandcastles), were more complex than the perceptually related metaphorical word items, we cannot be certain whether the complexity of the metaphorical relationship and/or the complexity of the pictorial arrays impeded the children from connecting and explaining more funtional and causal metaphors in pictures than in words. (See Table 1 for other inferred metaphorical items)

In order to gain a more complete understanding of the relationship of pictures and words to young children's ability to understand metaphorical relationships we are presently in the process of conducting an investigation in which both the complexity of the metaphorical relationship and the complexity of the pictorial representations are controlled. The effect of orally labelling pictures and children's ability to receive more benefit from pictorial representations is also being investigated.

In contrast to other studies that have indicated that young children are cognitively limited to abstracting similar perceptual characteristics (usually shape and color) between verbal items from different categories (Vosniadou & Ortony, 1983) this study indicates that although 4 year and 5 year olds were able to select and explain more inferred (functionally and causally related) items than 3 year olds (see Fig. 3 & 6) on some ocassions even children as young as 3 years old were able to give highly appropriate explanations for connecting the functionally and causally related metaphors. For example a child of 3 years 7 months explained that the functionally related items horse and bicycle were similar "because they both ride". Another child 3 years, 11 months stated that the causally related term sealing an envelope was like zipping up a zipper "because it makes things come together too".

An additional exploratory and pilot study was conducted in which we investigated whether young children could connect and explain metaphorical related pictorial terms which both exhibited salience imbalance and depicted psychological experiences (when the concepts were familiar to the children). The results of this study revealed that young children as young as 4 years and 5 years of age could both select and explain metaphorically related items that both exhibit salience imbalance and depict psychological experiences: For example a 4 year old child who connected a picture of a volcano with a picture of an angry child explained that they were both alike "because that's a volcano and its boomed off and she's mad too." A 5 year old explaining why a volcano and angry child should be connected stated that (the volcano) is thundered out and he (the child) is mad. The same child after connecting a picture of a dark cloud and a picture of a sad boy said they were alike "because that's a cloud and its crying inside and the girl is crying outside". Another 5 year old was more explicit in her explanation of why the dark cloud and sad boy were alike. The stated that "the dark cloud was gloomy and the sad boy was gloomy too".

In general the results of this study indicate that young children are not limited to perceiving and understanding perceptual metaphors but are also capable of perceiving and understanding causal and functional metaphors and perhaps even metaphors that exhibit salience imbalance provided that metaphorically related items are within the realm of the child's experience.

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